"Analysis of Critical Success Factors In Application of "DRYWALL" Technique in Construction Industry"

Pranoti Chandrakant Jagtap
Civil Engineering,
Baramati Pune India
pranoti.jagtap37@gmail.com

Abhijit N. Bhirud
Civil Engineering,
ICOER Pune India
abhijitbhirud11@gmail.com

Miss. Ingale Nilam Nandkumar
Civil Engineering
Phaltan Satara India
nilingale11@gmail.com

Abstract:- A drywall is a high-performance lightweight interior wall system consisting of a GI steel frame, encased in gypsum plasterboard on either side attached with self drilling drywall screws. The joints are then tapped and finished with gypsum jointing compounds. Drywall can be built three to four times faster than conventional masonry (brick/block) walls. Drywall name implies it is a water free process and hence can be put up much faster. Drywall is easy to put up and need less labour. Drywalls are eight to ten times lighter than masonry walls, reducing the dead load. This assumes significance in high-rise structures, resulting in not only structural cost saving, but a reduction in the burden of moving up material.

By using qualitative research methodology & by studying on the project VOYAGE to the stars by cloud9 of acropolis Purple developers luxury residential project located in Sr no 43/44, NIBM Road, Pune 411060, India Website: wwwcloud9estate.in as my case study I had collected the required data. This assumes significance in high-rise structures, resulting in not only structural cost saving, but a reduction in the burden of moving up material. Studies have shown that drywall leads to structural cost saving of as much as 15%. Drywall is made of gypsum plasterboard, which is 100% recyclable hence gives green construction. Drywalls are also water free, thus saving precious natural resources. Plasterboard Steel Stud Partition Systems are designed for use in both non fire-rated and fire-rated applications. Plasterboard Steel Stud Partition Systems consist of single or multiple layers of Plasterboard sheets, screw fixed to steel framing with corrosion resistant, bugle head screws. The non fire rated partitions detailed in this project information are suitable for standard partitioning construction in a range of new construction areas. They are also applicable in the renovation of all types of buildings. These speedily installed partitions provide smooth, durable, non-combustible, low cost, light weight systems that can also achieve acoustic performance ratings

Keywords : lightweight material, speedy construction, green construction, cost & time saving.

*****

1. Introduction

Construction materials have been subjected to major research and development over the past century. Drywall can be used to partition any interior and are the preferred choice of construction for the range of applications in homes, hotels, hospitals, schools, theatres, and industry. They are strong and robust (drywall of up to 15meters high have been built) and can typically last the lifeline of the building unless they are subjected to abuse or alteration. Drywall can be built three to four times faster than conventional masonry (brick/block) walls. Drywall is a high performance light weight partition system consisting of GI steel frame, encased with gypsum plasterboards on either side attached through self-drilling drywall screws. The joints are then taped and finished with gypsum jointing compounds. Drywall name implies it is a water free process and hence can be put up much faster. Drywall is easy to put up and need less labour. Drywalls are eight to ten times lighter than masonry walls, reducing the dead load. This assumes significance in high-rise structures, resulting in not only structural cost saving, but a reduction in the burden of moving up material. Studies have shown that drywall leads to structural cost saving of as much as 15%. Drywall is made of gypsum plasterboard, which is 100% recyclable hence gives green construction. Drywalls are also water free, thus saving precious natural resources. Plasterboard Steel Stud Partition Systems are designed for use in both non fire-rated and fire-rated applications.

This project gives details the approved methods of fixing and jointing Plasterboard Standard Core and Wet Area Plasterboard in non load-bearing non fire-rated steel stud partition systems. Plasterboard Steel Stud Partition Systems consist of single or multiple layers of Plasterboard sheets, screw fixed to steel framing with corrosion resistant, bugle head screws. The non fire rated partitions detailed in this project information are suitable for standard partitioning construction in a range of new construction areas. They are also applicable in the renovation of all types of buildings. These speedily installed partitions provide smooth, durable, non-combustible, low cost, light weight systems that can also achieve acoustic performance ratings. Plasterboard is manufactured to the requirements of Australian Standard AS/NZS 2588:1998 - "Gypsum plasterboard". It is to be

installed in accordance with the requirements of Australian Standard AS/NZS 2589.1:1997 - "Gypsum linings in residential and light commercial construction application and finishing Part 1: Gypsum plasterboard".

Waste drywall is regulated in Michigan as a construction and demolition waste under Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, and its administrative rules. An exemption was developed in 2003 that approves the use of drywall that has been processed to less than ¼ inch in size if it is at land applied at agronomic rates or added to compost at a rate less than 2.5 percent of the compost mixture. Gypsum wallboard is one of the largest waste components in residential construction. The United States produces approximately 15 million tons of new drywall per year. Approximately 12 percent of new construction drywall is wasted during installation. Most drywall waste is generated from new construction (64 percent), followed by demolition (14 percent), manufacturing (12 percent), and renovation (10 percent). The National Association of Home Builders Research Center (NAHBRC) estimates scrap wallboard is 26 percent by weight of new home construction waste. For a 2,000 square foot home, this equates to about 1.5 tons of material or about half a dump truck load. Based on information from the U.S. Census Bureau in 2005, Michigan issued building permits to construct 68,700 residential housing units. If each construction site produced 1.5 tons of drywall waste, this would equal over 100,000 tons of material from just residential building projects. An equal amount of drywall waste can be expected from commercial construction.

1.1 Objectives:

- To give faster construction.
- To reduce dead load of structure.
- To demonstrate use of recyclable material.
- To provide smooth finishing.

1.2Future scope

- Introduction to green construction materials in construction.
- Comparison of drywall to the traditional methods(brick/block).
- Analysis of amount of time & cost saved by use of drywall technique.
- Analysis of risk factors in execution of drywall.
- Preparation of checklists onsite for drywall technique.

2. Literature review & problem statement

Paper 1

ESTIMATE THE COST OF Installing & Finishing Drywall with Special Consideration Above 10' in Height submitted by Erich Seber, CPE

Erich Seber, CPE is the President of White Birch Enterprise LLC, a consulting company providing preconstruction services to owners and A/E firms serving primarily the Northeast. Seber holds a B.Eng. from Stevens Institute of Technology and a MBA from Bryant College. Throughout his thirty year career he has held positions from Project Manager to COO of firms listed in the ENR top 400. He has gained a diversified perspective by working for developers and a Fortune 500 aircraft manufacturer. His primary areas of expertise are design/build in the commercial sector and low income multifamily construction.

The purpose of this paper is to guide the estimator in doing a proper takeoff and estimate of both the installation and finishing of drywall (gypsum board). Gypsum board is the more technically accurate terminology but this paper will also use the more common term "drywall" interchangeably throughout this paper. This paper will strongly emphasize an accurate takeoff as the foundation to a predictable pricing effort. This paper uses the term "finishing" to represent the preparation of the gypsum board for the next application. The typical "finishing" operation is paper tape set in joint compound bedding followed by two coats of joint compound, followed by sanding to provide a smooth paintable surface. Depending on the finish, the effort to achieve the necessary level of "finishing" will be discussed. Estimating drywall production requires a consistent approach. Many projects requiring estimates are straight forward and fit within the standard efficiencies that the estimator/company has established. However, it will be pointed out in this paper when the established production rate needs adjustment. Special consideration is especially important when drywall is required greater than 10 feet above finish floor (aff).

Paper 2

Literature review and analysis of injury data associated with the use of plasterers'
Stil ts during the finishing of plasterboard in domestic construction : Research report 2009

WorkCover Assist Applied Research Project Final Report - 'Literature review and analysis of injury data associated with the use of plasterers' stilts during the finishing of plasterboard in domestic construction'. This research was funded under the WorkCover Assist Applied Research

Program. The grantee, the Association of Wall and Ceiling Industries (AWCI) undertook the research in partnership with VIOSH Australia, University of Ballarat. The conclusions in the final report are those of the authors and any views expressed are not necessarily those of WorkCover NSW. The purpose of the research was to undertake a comprehensive review of previous research relating to plasterers' work platform use and analysis of workers compensation data for injuries relating to work platform use by plasterers. A review of the literature was undertaken to identify the research and other related reports that may contribute to an understanding of the musculoskeletal and falls risks to plasterers undertaking finishing and cornice hanging tasks while using stilts, trestles or alternative equivalent working platforms. The research found that there is very limited information in the literature that specifically addresses the risks associated with plasterers' work platforms. The analysis of workers compensation data showed that plasterers suffered a significant number of compensable falls injuries and injuries associated with stepping off work platforms.

In Australia, plasterers undertake what is sometimes referred to as dry lining or hanging or fixing of plasterboard, wet area board and ceiling panels, and the fitting and finishing of architectural enrichments (for example Ceiling Roses). Stilts are not generally used while hanging plasterboard and are not used for any purpose on commercial construction sites however, plasterers' stilts are widely used as a working platform during the finishing of plasterboard on domestic construction sites. An alternative to using stilts is to use plasterers' trestles and it is also common for plasterers to use scaffolds and ladders as well as other available items such as milk crates and up-turned buckets as work platforms. As much contention exists over the use of stilts in plastering research was undertaken to gain a clearer picture of the size and nature of the stilts and trestle-related injury problem. The project drew on two sources of information over two phases: a literature review of previous research relating to plasterers' work
platform use and an analysis of Australian workers compensation data for injuries relating to work platform use by plasterers.

A review of the literature was undertaken to identify the research and other related reports that may contribute to an understanding of the musculo-skeletal and falls risks to plasterers undertaking finishing and cornice hanging tasks while using stilts, trestles or alternative equivalent working platforms. It was found that there is very limited information in the literature that specifically addresses the risks associated with plasterers' work platforms. However, there is general agreement that plasterers are over represented in the injury claims databases and many of the injuries are indeed associated with falls and over-exertion. The few reports that do specifically address work platforms suggest that ladders and scaffolding are implicated in many injuries. Stilts are also implicated although, in a majority of cases, the estimation of risk is hypothetical. Furthermore, there has been no assessment of the relative risk of the range of work platforms reported.

Plastering as an occupation is described by differing terminology, depending on the country of employment. For example, in the USA plastering specialists are known as drywall or wallboard installers and, depending on the stage of installation, the workers that perform the task often differ. Further to this, the drywall specialists are often classified as carpenters while painters are said to perform the finishing. Domestic construction carpenters in the USA undertake work associated with groundbreaking/layout, framing, roofing, interior finish other than drywall, exterior finish and remodel/demolition as well as installing drywall

Paper 3

An investigation into the use of plasterboard manual handling aids in the GB construction industry and factors helping an hindering the practicability of their application: Prepared by Tony Wynn the Health and Safety Laboratory for the Health and Safety Executive 2010

There is clear potential for risk of musculoskeletal injury when lifting and handling panel products such as plasterboard; and dry-lining operatives have been shown to have one of the highest prevalence rates for musculoskeletal disorders (MSD) in the construction industry. These problems are common because many of the materials they handle are heavy, and require the adoption of awkward postures (ie bending and twisting) when lifting. The introduction of ergonomic improvements may reduce physical load and the incidence of sickness absence. However, despite the existence of mechanical lifting devices for handling and assisting with the installation of plasterboard, there is reservation within the industry as to how practicable such solutions are in terms of their 'real world' application. The purpose of this report is to investigate the manual handling and work related risk factors for MSD associated with the installation of
plasterboard, and to evaluate the impact of manual handling aids in terms of risk reduction and the time taken to install plasterboard. This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the author alone and do not necessarily reflect HSE policy.

Manual handling of plasterboards in order to construct interior building walls and ceilings is a risk factor

for musculoskeletal complaints (van der Molen *et al.,* 2007) and plasterers have been shown to have one of the highest prevalence rates for musculoskeletal disorders (MSD) in the construction industry (Reid *et al.,* 2001). MSD are caused by many factors, including awkward postures (e.g. bending, stretching, twisting), repetitive movements, using force and manual handling (lifting and carrying) and these activities are recognised as a regular component of plasterers' work (Chiou *et al*., 1997; Lipscomb *et al.,* 1997; Pan and Chiou, 1999; Smallwood
et al., 2006). They can occur in any part of the body, but are particularly common in the lower back, neck, shoulders, elbows, wrists and hands. Furthermore, repeated bending or standing for long periods, particularly on uneven surfaces, can lead to discomfort in the legs, knees and feet (van der Molen *et al.,* 2007). These problems are common in plasterers because, many of the materials they handle are heavy, and often require the adoption of awkward postures (i.e. bending and twisting) when lifting and fitting panels (Cowley and Leggett, 2003; Reid *et al.,* 2001). Despite the existence of mechanical lifting devices for handling and assisting with the installation of plasterboard, there is reservation within the construction industry as to how practicable such solutions are in terms of their "real world" application (van der Molen *et al.,* 2007). The aim of this research is to investigate the manual handling and work related risk factors for MSD associated with the installation of plasterboard and to evaluate the impact of manual handling aids, in terms of risk reduction and the time taken to install plasterboard.

Paper 4

Seismic Performance of Gypsum Walls – Experimental Test Program

Kurt M. McMullin San Jose State University San Jose, California & Dan Merrick San Jose State University San Jose, California July 1, 2001

Seventeen experimental tests were conducted to meet the required research objectives of determining the cost-damage relationship and engineering characteristics of residential gypsum wallboard partition walls. Specimens were 8-foot high and 16-foot long, double-sided with ½" gypsum wallboard. Test variables included: fastener type and spacing, loading protocol, top-of-wall boundary condition, method of attaching the wallboard to the top sill, wall opening layout, innovative construction methods, influence of door and floor trim, and repair strategies. Instrumentation measured applied load, lateral deflection at the top of the wall, lateral deflection at the bottom of the wall, shear distortion of the piers, and uplift at the door trimmers. Findings include a distinct change in strength for walls built with various fastener types and wall penetration layouts. Damage patterns begin with the initiation of cracks at the wall penetrations and cracking of the paint over a few fastener heads, usually initiating at drift levels near 0.25%. Maximum loads are sustained at drifts of approximately 1 to 1.5%. At this point, one of two failure modes initiates. The first failure mode seen was loosening of the wallboard from the framing by pulling fastener heads through the back of the wallboard. The second failure mode included failure of the taped wall joints and racking movement of the individual wallboard panels. Strength degradation may be severe or more gradual for different walls. Monotonic loading protocols closely predict the cyclic force-displacement backbone relationship. The overall behavior and levels of damage appears to be related to the rigidity and geometry of the boundary elements of the wall. Rigid restraint from the intersecting walls appears to significantly increase the lateral strength and stiffness.

Cost-damage relationships appear to be similar to a step-function. The cost of repair seems closely related to the number of tradesmen required for repair work. While a single multi-skilled contractor can repair minor cracking, larger levels of damage may require demolition crews, drywall crews, carpenters and paint crews. Total loss of economic value of the wall appears to occur at drifts of approximately two percent.

3. Conclusion

This technique drywall gives progress of work as per the schedule and there is no delay in the construction work for completion of work with less dead load as compare to brick work with minimum wastage and superior smooth finishing is achieved.

- This technique gives faster construction that is 3 to 4 times masonry construction.
- It reduces dead load of structure it gives 8 to 10 times lighter than masonry work.
- It gives use of recyclable material which is made of environment friendly material.
- It gives smooth finishing seamless & crack free surface, allowing ease of decoration via paint, tiles or wallpapers.

4. References

[1] Construction Specification Institute (CSI) MasterFormat 2004 Edition

[2] Gypsum Associaton GA-214-07 Recommended Levels of Gypsum Board Finish

[3] Gypsum Associaton GA-216-2007 Application and Finishing of Gypsum Panel Products Sample Sketches, TakeOff, and Pricing Sheets available online in PDF format.

[4] (1992). Health and Safety - The Manual Handling Operations Regulations 1992, No.2793, 5pp

[5] Albers, J.T., Li, Y., Sprague, S., Stinson, R. and Bhattacharya, A. (1997). An ergonomic education and evaluation program for apprenticew carpenters. American Journal of Industrial Medicine, 32, 641-646.

[6] Chiou, S.S., Pan, C.S. and Keane, P. (2000). Traumatic Injury Among Drywall Installers, 1992 to 1995. Journal of Occupational and Environmental Medicine, 42, (11)

[7] http://www.hse.gov.uk/construction/cdm/legal.htm

[8] Behm, M. Linking Construction Fatalities to the Design for Construction Safety Concept Safety Science 43 (2005) 589-611

[9] Estimate the cost of Installing & Finishing Drywall with Special Consideration Above 10' in Height submitted by Erich Seber, CPE

[10] Literature review and analysis of injury data associated with the use of plasterers' Stil ts during the finishing of plasterboard in domestic construction : Research report 2009

[11] Seismic Performance of Gypsum Walls – Experimental Test Program Kurt M. McMullin San Jose State University San Jose, California & Dan Merrick San Jose State University San Jose, California July 1, 2001